He has also demonstrated by injection that a network similar to the one just described is present in the web-membrane of the pectoral fin of the perch. The lung of the toad also exhibits a modification of the plasmatic network in the form of extremely fine hollow processes, which either stretch completely across the mesh from capillary to capillary, or terminate in finely pointed or blunt extremities among the epithelia or nuclei which stud the membrane of the air-vesicle.

In the proper epithelial portion of the skin of batrachians or of mammals, the author has not yet been able to prove distinctly that the plexuses are to be found, but he has been so far successful in this direction as to have displayed them satisfactorily in the follicles and bulbs of the whisker hairs of the mole, mouse, and kitten. From certain observations, however, which cannot here be detailed, he thinks it more than probable, not only that plasma-networks are present in the epithelial layer of the batrachian skin, but also in a corresponding part of the human cutis.

With regard to the offices performed by these networks, the author thinks it probable that all those found in the epidermal or mucous tissues are intimately connected with the function of secretion, and in a minor degree also perhaps with that of absorption; while those situated in the deeper parts of the organism, such as muscle and fibrous tissue, are employed in conveying blood-plasma to, and effete matters from, the tissues through which they pass or with which they may be in contact.

XI. "Aërial Tides." By Pliny Earle Chase, A.M., S.P.A.S. Communicated by Major-General Sabine, Pres. R.S. Received June 16, 1864.

The remarkable coincidence which I have pointed out* between the theoretical effects of rotation and the results of barometrical observations, has led me to extend my researches with a view of defining more precisely some of the most important effects of lunar action on the atmosphere. The popular belief in the influence of the moon on the weather, which antedates all historical records, has received at various times a certain degree of philosophical sanction. Herschel and others have attempted partially to formulate that influence by empirical laws, but the actual character of the lunar wave that is daily rolled over our heads, appears never to have been investigated.

Major-General Sabine has shown that the moon produces a diurnal variation of the barometer, amounting to about ·006 of an inch at St. Helena, which is nearly equivalent to $\frac{1}{10}$ of the average daily variation (Phil. Trans. 1847, Art. V.). This would indicate a tidal wave of rather more than 1 ft. for each mile that we ascend above the earth's surface, or from 3 to 6 ft. near the summits of the principal mountain-chains. It is easy to believe that the rolling of such a wave over the broken surface of the earth may

* See Proceedings of Amer. Philos. Soc. vol. ix. p. 283.

exert a very important influence on the atmospheric and magnetic currents, the deposition of moisture, and other meteorological phenomena. As the height of the wave varies with the changing phases of the moon*, its effects must likewise vary in accordance with mathematical laws, the proper study of which must evidently form an important branch of meteorological science.

Besides this daily wave, there appears to be a much larger, but hitherto undetected, weekly wave. M. Flangergues†, an astronomer at Viviers in France, extended his researches through a whole lunar cycle, from Oct. 19, 1808 to Oct. 18, 1827, and he inferred from his observations—

1. That in a synodical revolution of the moon, the barometer rises regularly from the second octant, when it is the lowest, to the second quadrature, when it is the highest, and then descends to the second octant.

2. That the varying declination of the moon modifies her influence, the barometer being higher in the northern lunistice than in the southern.

The more recent and more complete observations at St. Helena give somewhat different results, which serve to confirm the natural *à priori* conviction that there are two maxima and two minima in each month. The means of three years' hourly observations, indicate the existence of waves which produce in the first quarter a barometric effect of +·004 in., in the second quarter of —·016 in., in the third quarter of +·018 in., and in the fourth quarter of —·006 in.—results which appear to be *precisely* accordant, in their general features, with those which would be naturally anticipated from the combination of the cumulative action of the moon's attraction, with the daily wave of rotation, and the resistance of the æther.

One peculiarity of the lunar-aërial wave deserves attention, for the indirect confirmation that it lends to the rotation theory of the aërobaric tides, and the evidence it furnishes of opposite tidal effects, which require consideration in all investigations of this character. When the daily lunar tides are highest, their pressure is greatest, the lunar influence accumulating the air directly under the meridian, so as to more than compensate for the diminished weight consequent upon its "lift." But in the general aërial fluctuations, as we have seen heretofore, and also in the weekly tides which we are now considering, a high wave is shown by a low barometer, and *vice versâ*. The daily blending of heavy and light waves produces oscillations which are indicated by the alternate rise and fall of the barometer and thermometer at intervals of two or three days.

M. Flangergues's observations at perigee and apogee seem to show that a portion of the movement of the air by the moon is a true lift, which, like the lift of rotation, must probably exert an influence on the barometer. On comparing the *daily* averages at each of the quadratures and syzygies, I found the difference of temperature too slight to warrant any satisfactory inference, but a similar comparison of the *hourly* averages, at hours when

* The height at St. Helena appears to fluctuate between about ·9 and 1·6 ft.

† Bib. Univ., Dec. 1827.

the sun is below the horizon, gave such results as I anticipated; as will be seen by a reference to the following

Table of Barometric and Thermometric Means at the Moon's Changes.

Moon's Phase.	Average Height of Barometer, in inches.	Height of Lunar Weekly Tides.	Height of Lunar Daily Tides.	Daily Height of Thermo-meter.	Thermo-meter at 12 P.M.	Thermo-meter at 4 A.M.
		in.	in.	°	°	°
Full............	28·270	−·0115	·0054	67·67	60·22	59·787
Third Quarter	28·289	+·0065	·0087	61·68	60·41	59·824
New	28·282	+·0005	·0064	61·65	60·31	59·716
First Quarter	28·286	+·0044	·0047	61·63	60·37	59·823

In obtaining the above averages, I was obliged to interpolate for such changes as took place on Sundays or holidays, when no observations were taken. The interpolation, however, does not change the general result, and on some accounts the Table is more satisfactory than if the observations had been made with special reference to the determination of the lunar influences, accompanied, as such a reference would very likely have been, by a bias to some particular theory.

The thermometric and barometric averages show a general correspondence in the times of the monthly maxima and minima,—the correspondence being most marked and uniform at midnight, when the air is most removed from the direct heat of the sun, and we might therefore reasonably expect to find the strongest evidences of the relations of temperature to lunar attraction.

By taking the difference between the successive weekly tides, we readily obtain the amount of barometric effect in each quarter. The average effect is more than three times as great in the third and fourth quarters as in the remaining half-month,—a fact which suggests interesting inquiries as to the amount of influence attributable to varying centrifugal force, solar conjunction or opposition, temperature, &c.

Although, as in the ocean tides, there are two simultaneous corresponding waves on opposite sides of the earth, those waves are not of equal magnitude, the barometer being uniformly higher when the moon is on the inferior meridian, and its attraction is therefore exerted in the same direction as the earth's, than when it is on the superior meridian, and the two attractions are mutually opposed. Some of the views of those who are not fully satisfied with the prevailing theory of the ocean-tides, derive a partial confirmation from this fact.

I find, therefore, marked evidences of the same lunar action on the atmosphere as on the ocean, the combination of its attraction with that of the sun producing both in the air and water, spring tides at the syzygies,

and neap tides at the quadratures; and I believe that the most important normal atmospheric changes may be explained by the following theory:—

The attraction- and rotation-waves, as will be readily seen, have generally opposite values, the luni-solar wave being

Descending, from 0° to 90°* and from 180° to 270°,
Ascending, from 90° to 180° and from 270° to 0°;

while the rotation-wave is

Ascending, from 330° to 60° and from 150° to 240°,
Descending, from 60° to 150° and from 240° to 330°.

From 60° to 90° and from 240° to 270°, both waves are descending, while from 150° to 180° and from 330° to 360° both are ascending. In consequence of this change of values, besides the principal maxima and minima at the syzygies and quadratures, there should be secondary maxima and minima† at about 60° in advance of those points.

The confirmation of these theoretical inferences by the St. Helena observations appears to me to be quite as remarkable as that of my primary hypothesis. If we arrange those observations in accordance with the moon's position, and take the average daily height of the barometer, we obtain the following

Table of the Lunar Barometric Tides.

Moon's Position.	Mean Daily Height of the Barometer at St. Helena, 28 inches + the numbers in the Table.			
	1844.	1845.	1846.	1844–6. Average.
° 0	·2621	·3020	·2701	·2781
15	·2650	·3058	·2693	·2800
30	·2707	·3153	·2707	·2856
45	·2691	·3165	·2688	·2848
60	·2625	·3077	·2688	·2797
75	·2682	·3093	·2783	·2853
90	·2667	·3184	·2800	·2884
105	·2593	·3170	·2721	·2828
120	·2595	·3124	·2686	·2802
135	·2677	·3099	·2691	·2822
150	·2712	·3118	·2715	·2848
165	·2710	·3104	·2735	·2850
180	·2621‡	·3020	·2701	·2781

This Table shows—

1. That the average of the three years corresponds *precisely* with the theory, except in the secondary maximum, which is one day late.

* Counting θ from either syzygy.

† The secondary maxima and minima should correspond with the daily maxima and minima, which occur at St. Helena at about 4^h and 10^h A.M. and P.M., giving $\theta = 60°$ a maximum, and $\theta = 150°$ a minimum.

‡ Since the tabular numbers represent the *semiaxes* of the barometric curve, and not the simple *ordinates*, the values for 0° and 180° are the same.

2. That the primary maximum occurred at the quadratures in 1845 and 1846, and one day earlier in 1844.

3. That the primary minimum occurred at the syzygies in 1844 and 1845, and one day later in 1846.

4. That 1846 was a disturbed year; and if it were omitted from the Table, each of the remaining years, as well as the average, would exhibit an entire correspondence with theory, except in the primary maximum of 1844.

5. That 1845 was a normal year, the primary and secondary maxima and minima all corresponding with theory, both in position and relative value.

XII. "On the Microscopical Structure of Meteorites." By H. C. Sorby, F.R.S., &c. Received June 7, 1864.

For some time past I have endeavoured to apply to the study of meteorites the principles I have made use of in the investigation of terrestrial rocks, as described in my various papers, and especially in that on the microscopical structure of crystals (Quart. Journ. Geol. Soc. 1858, vol. xiv. p. 453). I therein showed that the presence in crystals of "fluid-, glass-, stone-, or gas-cavities" enables us to determine in a very satisfactory manner under what conditions the crystals were formed. There are also other methods of inquiry still requiring much investigation, and a number of experiments must be made which will occupy much time; yet, not wishing to postpone the publication of certain facts, I purpose now to give a short account of them, to be extended and completed on a subsequent occasion*.

In the first place it is important to remark that the olivine of meteorites contains most excellent "glass-cavities," similar to those in the olivine of lavas, thus proving that the material was at one time in a state of igneous fusion. The olivine also contains "gas-cavities," like those so common in volcanic minerals, thus indicating the presence of some gas or vapour (Aussun, Parnallee). To see these cavities distinctly, a carefully prepared thin section and a magnifying power of several hundreds are required. The vitreous substance found in the cavities is also met with outside and amongst the crystals, in such a manner as to show that it is the uncrystalline residue of the material in which they were formed (Mezö-Madaras, Parnallee). It is of a claret or brownish colour, and possesses the characteristic structure and optical properties of artificial glasses. Some isolated portions of meteorites have also a structure very similar to that of stony lavas, where the shape and mutual relations of the crystals to each other prove that they were formed *in situ*, on solidification. Possibly some entire meteorites should be considered to possess this peculiarity (Stannern, New Concord), but the evidence is by no means conclusive, and what crystallization has taken place *in situ* may have been a secondary result; whilst in others the constituent particles have all the characters of broken fragments

* The names given thus (Stannern) indicate what meteorites I more particularly refer to in proof of the various facts previously stated.